

HEATHKIT[®] MANUAL



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information (616) 982-3411
Credit (616) 982-3561
Replacement Parts (616) 982-3571

Technical Assistance Phone Numbers

8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only
R / C, Audio, and Electronic Organs (616) 982-3310
Amateur Radio (616) 982-3296
Test Equipment, Weather Instruments and
Home Clocks (616) 982-3315
Television (616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive,
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Computer Hardware (616) 982-3309
Computer Software (616) 982-3860
Heath Craft Wood Works (616) 982-3423



YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

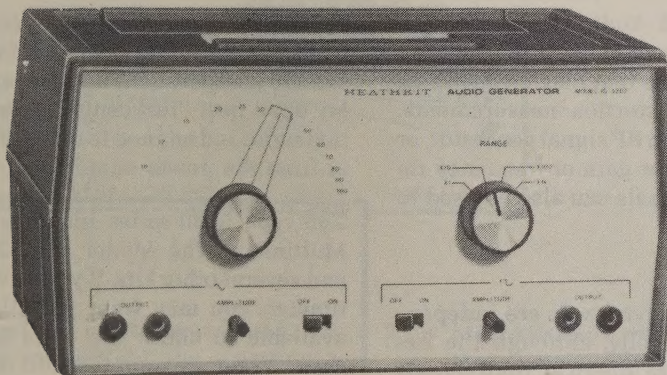
Heathkit® Manual

for the

AUDIO GENERATOR

Model IG-5282

595-1959-03



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model IG-5282 Audio Generator is an audio frequency signal generator. It provides sine wave and square wave signals that may be used as a signal source for harmonic distortion measurements, as an external modulator for an RF signal generator, or in tests of audio amplifiers for gain or frequency response. The square wave signals can also be used to trigger digital instruments.

The sine wave and square wave levels are independently adjustable from 0-3 volts, although the frequencies, 10 Hz to 100 kHz, are identical. Both signals may be used simultaneously or independently.

The Audio Generator is housed in the 5280-series instrument cabinet. This cabinet has a convenient storage compartment and is stackable to help you to lay out a neat "test center" arrangement. Each kit in this series is designed to operate from batteries as well as from the power supply.

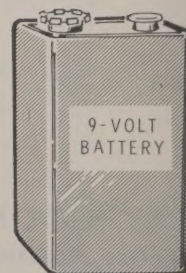
The type 5280-series includes the Model IM-5284 Multimeter, the Model IPA-5280-1 Power Supply, and several other kits. If you have purchased the Multimeter, you may want to build it first so that it is available to check the other kits as you assemble them. You may want to build the power supply next to avoid the need for batteries.

BATTERIES

If you intend to operate your Audio Generator on battery power, you should purchase two 9-volt transistor batteries, NEDA #1604, at this time for use in your kit. Representative manufacturers and their type numbers are:

Eveready #216, PP3
Burgess #2U6

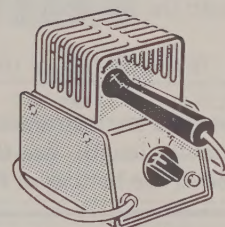
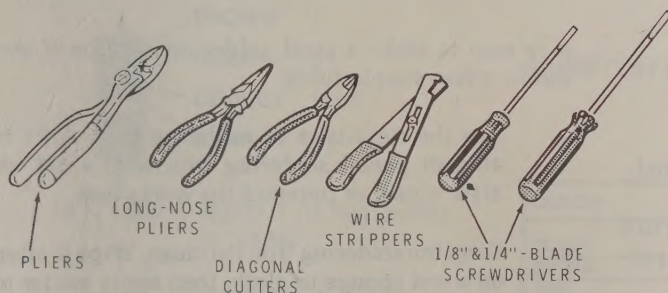
Mallory #TR-146X (long life)
RCA #VS323
Hellesens #410
Varta #438
CEI #6F22



ASSEMBLY NOTES

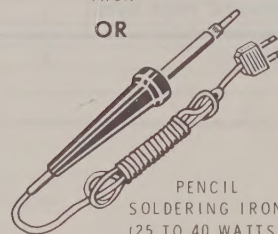
TOOLS

You will need these tools to assemble your kit.



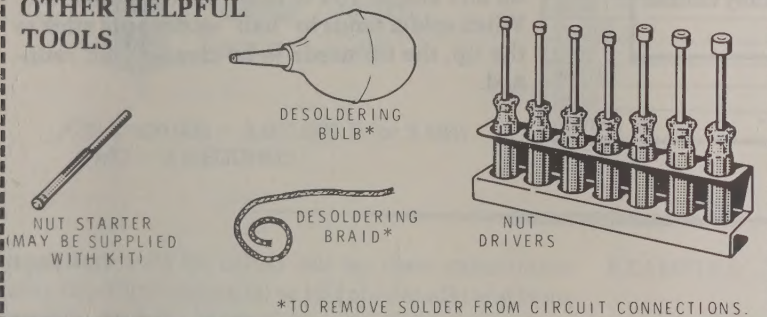
HEATHKIT
SOLDERING
IRON

OR



PENCIL
SOLDERING IRON
(25 TO 40 WATTS)

OTHER HELPFUL TOOLS



*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

- Follow the instructions carefully and read the entire step before you perform the operation.
- The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.
- Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.
- Position all parts as shown in the Pictorials.
- Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:
- In the Parts List,
 - At the beginning of each step where a component is installed,
 - In some illustrations,
 - In the Schematic,
 - In the section at the rear of the Manual.
7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

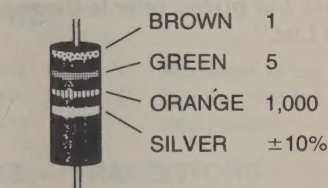
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

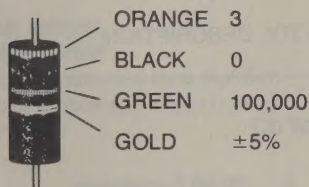
PARTS

Resistors will be called out by their resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.

EXAMPLES:

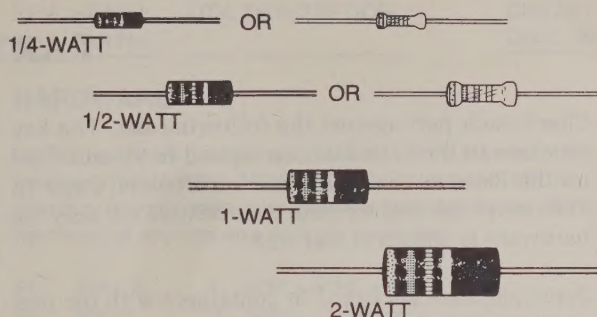


$$15 \times 1,000 = 15,000 \Omega \text{ (15,000 OHMS), or "15 k}\Omega\text{"}$$



$$30 \times 100,000 = 3,000,000 \Omega \text{ (or 3 M}\Omega\text{)}$$

$$3 \text{ M}\Omega = 3 \text{ MEGOHMS}$$

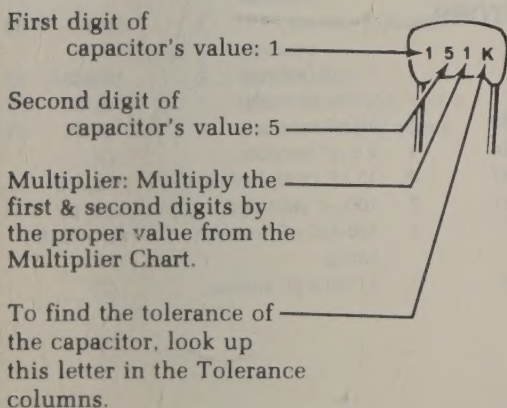


RESISTOR COLOR CODE



COLOR	1st DIGIT	2nd DIGIT	MULTIPLY BY
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD			.1
SILVER			.01

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:



EXAMPLES:

$$151K = 15 \times 10 = 150 \text{ pF}$$

$$759 = 75 \times 0.1 = 7.5 \text{ pF}$$

NOTE: The letter "R" may be used at times to signify a decimal point; as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10pF OR LESS	LETTER	OVER 10pF
0	1	$\pm 0.1 \text{ pF}$	B	
1	10	$\pm 0.25 \text{ pF}$	C	
2	100	$\pm 0.5 \text{ pF}$	D	
3	1000	$\pm 1.0 \text{ pF}$	F	$\pm 1\%$
4	10,000	$\pm 2.0 \text{ pF}$	G	$\pm 2\%$
5	100,000		H	$\pm 3\%$
			J	$\pm 5\%$
8	0.01		K	$\pm 10\%$
9	0.1		M	$\pm 20\%$

PARTS LIST

Check each part against the following list. The key numbers in the Parts List correspond to the numbers on the Parts Pictorial (Illustration Booklet, Page 1). Parts may vary slightly from the illustrations; only the hardware is shown actual size.

Some parts are packaged in containers with the part number marked on the outside. Except for the initial parts check, keep these parts in their containers so they can easily be identified when they are called for in the assembly steps.

Save all packaging material until all parts have been located.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
------------	-------------------	------	-------------	----------------------

RESISTORS

NOTE: The following resistors have a tolerance of 5%. 5% is indicated by a fourth color band of gold. The resistors may be packed in more than one envelope.

A1	6-220	2	22 Ω (red-red-black)	R23, R24
A1	6-101	1	100 Ω (brown-black-brown)	R15
A1	6-391	1	390 Ω (orange-white-brown)	R17
A1	6-471	2	470 Ω (yellow-violet-brown)	R13, R30
A1	6-561	1	560 Ω (green-blue-brown)	R14
A1	6-102	2	1000 Ω (brown-black-red)	R32, R34
A1	6-222	1	2200 Ω (red-red-red)	R29
A1	6-472	1	4700 Ω (yellow-violet-red)	R12
A1	6-822	2	8200 Ω (gray-red-red)	R18, R31
A1	6-103	1	10 k Ω (brown-black-orange)	R28
A1	6-333	1	33 k Ω (orange-orange-orange)	R10
A1	6-433	2	43 k Ω (yellow-orange-orange)	R4, R8

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Resistors (cont'd.)

A1	6-104	3	100 k Ω (brown-black-yellow)	R9, R22, R25
A1	6-124	1	120 k Ω (brown-red-yellow)	R19
A1	6-224	2	220 k Ω (red-red-yellow)	R20, R21
A1	6-434	2	430 k Ω (yellow-orange-yellow)	R3, R7
A1	6-435	2	4.3 M Ω (yellow-orange-green)	R2, R6
A1	1-195	2	43 M Ω (yellow-orange-blue)	R1, R5

CAPACITORS

B1	28-1	2	2.2 pF (red-red-white) phenolic	C9, C10
B2	20-130	1	12 pF mica	C8
B3	25-924	1	2.2 μ F tantalum	C4
B3	25-917	2	10 μ F (10M) tantalum	C5, C6
B4	25-117	2	100 μ F electrolytic	C3, C7
B5	26-9	1	420-420 pF 2-section tuning	C1A/C1B
B6	31-52	1	8.0-60.0 pF trimmer	C2

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CONTROLS

C1	10-1090	1	2000 Ω (2K)	R33
C1	10-333	1	10 k Ω	R26
C2	10-918	1	500 Ω	R16
C2	10-386	1	10 k Ω	R27
C2	10-941	1	100 k Ω	R11

SWITCHES

C3	60-70	1	Slide switch (2 lug)	SW3
C4	60-71	1	Slide switch (6 lug)	SW2
C5	63-17	1	Rotary switch	SW1

DIODES — TRANSISTORS

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

D1	56-56	3	1N4149 diode	D1, D2, D3
D2	417-235	4	2N4121 transistor	Q3, Q5, Q6, Q7
D2	417-169	2	MPF105	Q1, Q2
D2	417-801	1	MPSA20	Q4

CONNECTORS — JACKS — PLUGS

E1	260-1	2	Alligator clip
E2	432-798	2	Battery connector
E3	436-11	2	Red banana jack/with hardware
E3	436-22	2	Black banana jack/with hardware
E4	438-47	2	Banana plug
E5	70-10	1	Black banana plug sleeve
E5	70-11	1	Red banana plug sleeve

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
---------	----------------	------	-------------	-------------------

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4, or, HDW #6 and #8, etc.). You may have to open more than one packet to locate all the hardware of any one size (#6, for example).

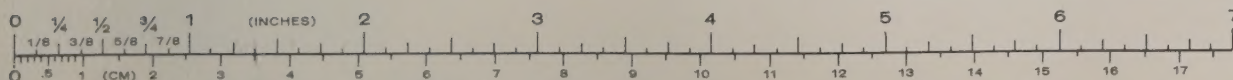
F1	250-138	3	6-32 $\times$ 3/16" screw
F2	250-56	13	6-32 $\times$ 1/4" screw
F3	250-592	2	#6 $\times$ 3/8" screw (coarse thread)
F4	250-1248	2	6-32 $\times$ 3/8" screw (fine thread)
F5	250-162	5	6-32 $\times$ 1/2" screw
F6	252-3	9	6-32 nut
F7	252-195	5	6-32 self-retaining nut
F8	254-1	13	#6 lockwasher
F9	250-15	1	8-32 $\times$ 1/8" setscrew
F10	250-22	2	8-32 $\times$ 7/16" setscrew
F11	252-7	1	3/8" nut
F12	253-10	1	3/8" flat washer
F13	254-5	1	3/8" lockwasher

LARGE PARTS

G1	92-662	1	Cabinet consisting of:
	92-659	1	Cabinet top
	92-660	1	Cabinet bottom
	92-661	1	Cabinet cover (assembled to top)
	92-668	1	Cover plate
G2	200-1290	1	Chassis
G3	203-1868-2	1	Front panel
G4	206-1244	1	Upper shield
G5	206-1245	1	Lower shield

WIRE

341-1	36"	Black test lead
341-2	36"	Red test lead
344-50	18"	Black wire
344-52	24"	Red wire
344-55	24"	Green wire
344-59	24"	White wire



KEY No.	HEATH Part No.	QTY.	DESCRIPTION
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CIRCUIT Comp. No.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION
------------	-------------------	------	-------------

CIRCUIT Comp. No.

MISCELLANEOUS

	85-2052-1	1	Circuit board
G6	73-1	1	Rubber grommet
G7	463-28	1	Dial pointer
G8	462-140	1	Knob
G9	462-207	1	Knob with pointer
G10	456-41	1	Coupling
G11	431-26	1	1-lug terminal strip
G12	431-28	1	2-lug terminal strip
G13	73-64	2	Foam strip

Solder

PRINTED MATERIAL

G14	391-34	1	Blue and white label
		1	Assembly Manual (See Page 1 for part number)
	597-260	1	Parts Order Form

STEP-BY-STEP ASSEMBLY

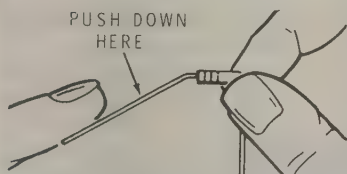
CIRCUIT BOARD ASSEMBLY

START

In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

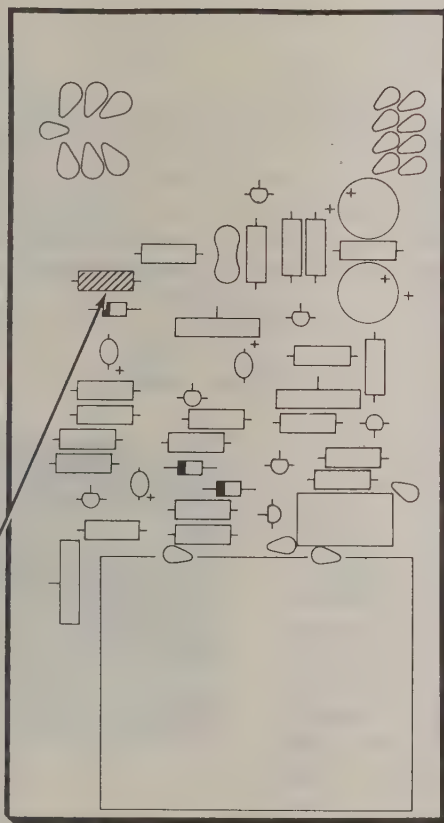
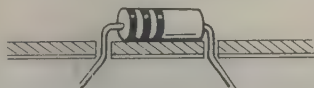
- () Position the circuit board as shown with the printed side (not the foil side) up.

- () R25: Hold a 100 k Ω (brown-black-yellow) resistor by the body as shown and bend the leads straight down.



- () Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

- () Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.

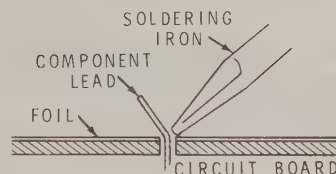


PICTORIAL 1

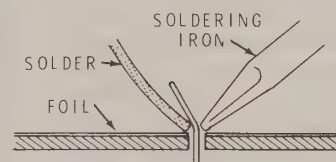
CONTINUE

- () Solder the resistor leads to the circuit board as follows:

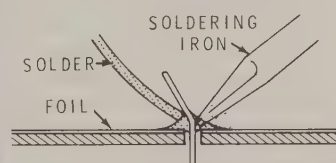
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



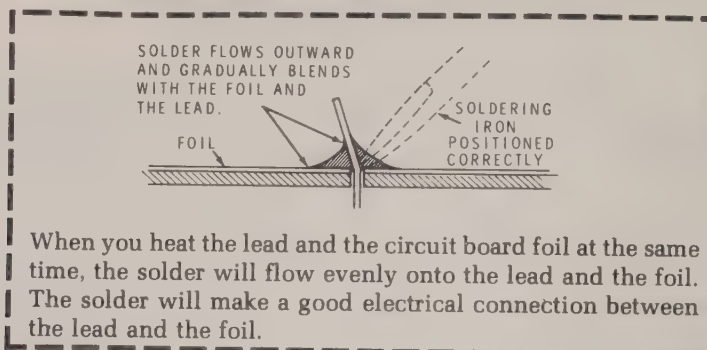
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



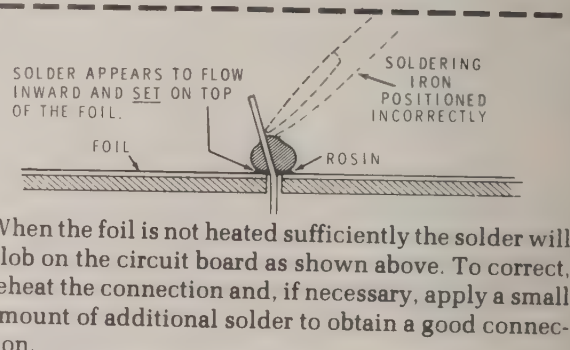
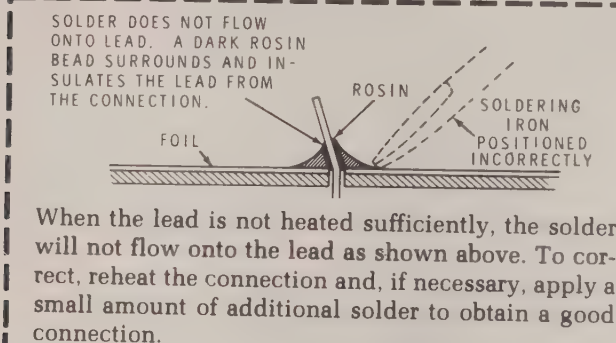
- () Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

- () Check the connection. Compare it to the illustrations on Page 10. After you have checked the solder connections, proceed with the assembly on Page 11. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION



POOR SOLDER CONNECTIONS



SOLDER BRIDGES

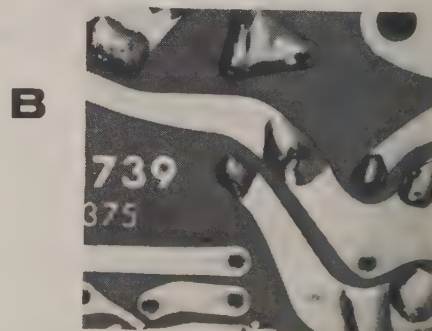
A solder bridge between two adjacent foils is shown in photograph A. Photograph B shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is; always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of each circuit board has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



A

SOLDER BRIDGE



B

START

- () Position the circuit board as shown.

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. THE CIRCUIT WILL NOT WORK IF THE DIODE IS INSTALLED BACKWARDS. See Detail 2A.

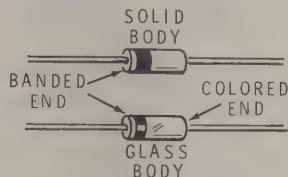


IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



Detail 2A

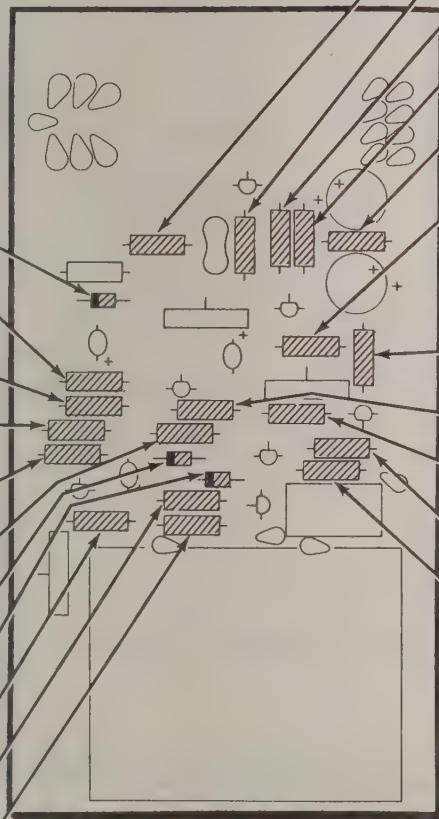
If your diode has a solid body, the band is clearly defined. If your diode has a glass body do not mistake the colored end **inside** the diode for the banded end. Look for a band painted on the **outside** of the glass.



- () D3: 1N4149 diode (#56-56).
- () R22: 100 k Ω (brown-black-yellow).
- () R20: 220 k Ω (red-red-yellow).
- () R21: 220 k Ω (red-red-yellow).
- () R19: 120 k Ω (brown-red-yellow).
- () R18: 8200 Ω (gray-red-red).
- () D2: 1N4149 diode (#56-56).
- () D1: 1N4149 diode (#56-56).
- () R15: 100 Ω (brown-black-brown).
- () R14: 560 Ω (green-blue-brown).
- () R13: 470 Ω (yellow-violet-brown).
- () Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

- () R29: 2200 Ω (red-red-red).
- () R28: 10 k Ω (brown-black-orange).
- () R31: 8200 Ω (gray-red-red).
- () R32: 1000 Ω (brown-black-red).
- () R30: 470 Ω (yellow-violet-brown).
- () R10: 33 k Ω (orange-orange-orange).
- () Solder the leads to the foil and cut off the excess lead lengths.
- () R9: 100 k Ω (brown-black-yellow).
- () R24: 22 Ω (red-red-black).
- () R23: 22 Ω (red-red-black).
- () R17: 390 Ω (orange-white-brown).
- () R12: 4700 Ω (yellow-violet-red).
- () Solder the leads to the foil and cut off the excess lead lengths.

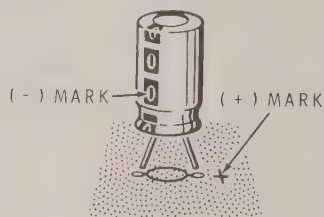


PICTORIAL 2

START ➡

() C8: 12 pF mica capacitor.

When you install the following tantalum capacitors, position the negative (-) marked lead opposite the positive (+) sign on the circuit board.

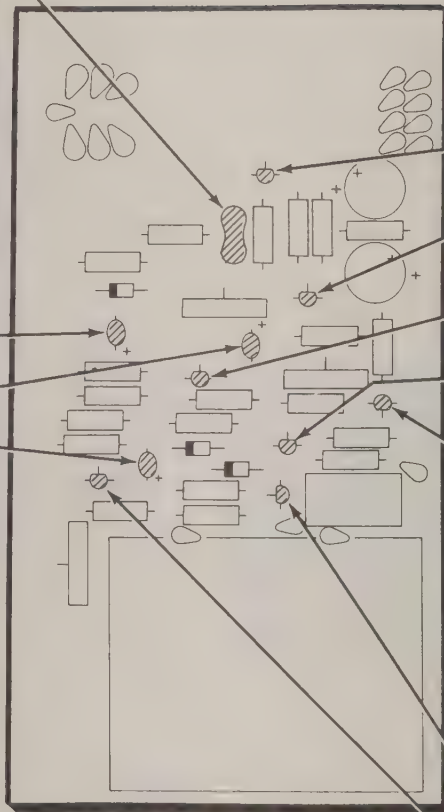


() C5: 10 μ F tantalum capacitor.

() C6: 10 μ F tantalum capacitor.

() C4: 2.2 μ F tantalum capacitor.

() Solder the leads to the foil and cut off the excess lead lengths.

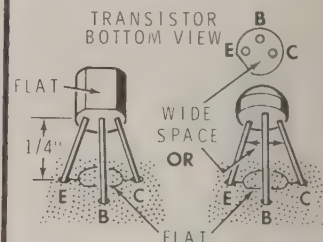


PICTORIAL 3

CONTINUE ➡

In the following steps, install each transistor as follows:

1. Refer to the illustration below and identify the E, B, and C leads.
2. Insert the leads into the corresponding E, B, and C holes in the circuit board.
3. Position the transistor 1/4" above the circuit board.
4. Turn the circuit board over, solder the leads to the foil, and cut off the excess lead lengths.



() Q7: 2N4121 transistor (#417-235).

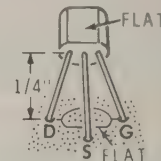
() Q6: 2N4121 transistor (#417-235).

() Q5: 2N4121 transistor (#417-235).

() Q3: 2N4121 transistor (#417-235).

() Q4: MPSA20 transistor (#417-801).

NOTE: Identify the D, S, and G leads and install the next two transistors as shown. Solder the leads to the foil.



() Q1: MPF105 transistor (#417-169).

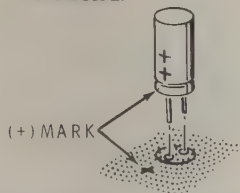
() Q2: MPF105 transistor (#417-169).

() Check to see that all leads are soldered to the foil and cut off any excess lead lengths.

START

NOTE: When you install an electrolytic capacitor, match the + mark on the capacitor to the + mark on the circuit board.

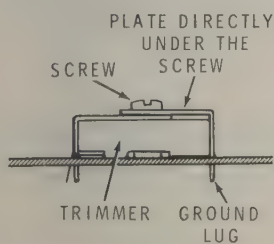
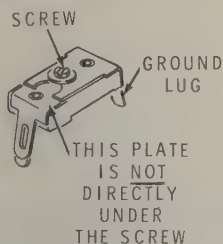
- () C7: 100 μ F electrolytic capacitor. Mount the capacitor vertically. Match the + mark on the capacitor to the + mark on the board.



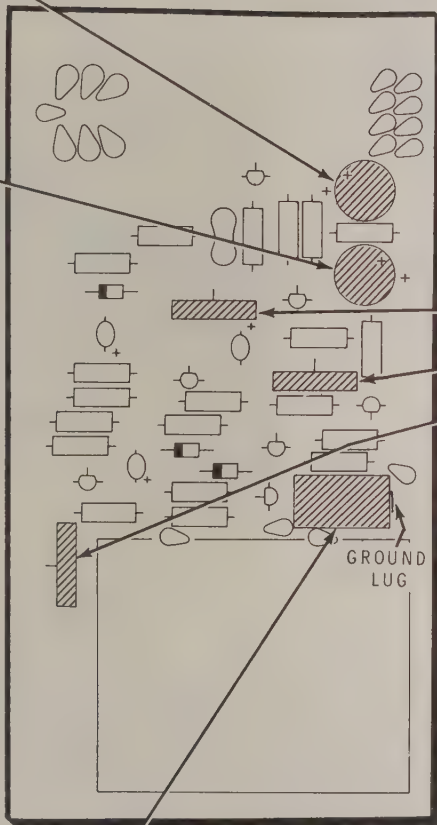
- () C3: 100 μ F electrolytic capacitor.

- () Solder the leads to the foil and cut off the excess lead lengths.

NOTE: In the following step, IT IS VERY IMPORTANT to solder the correct trimmer lug to the correct foil. One lug will be called the ground lug. This is the lug that is connected to the metal plate directly under the screw on the trimmer.



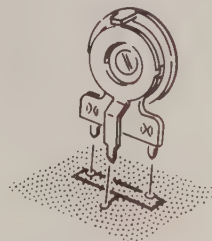
- () C2: 8 to 60 pF trimmer capacitor. Solder the lugs to the foil. Note the position of the ground lug.



PICTORIAL 4

CONTINUE

NOTE: Seat the following controls firmly against the circuit board and solder the lugs to the foil.

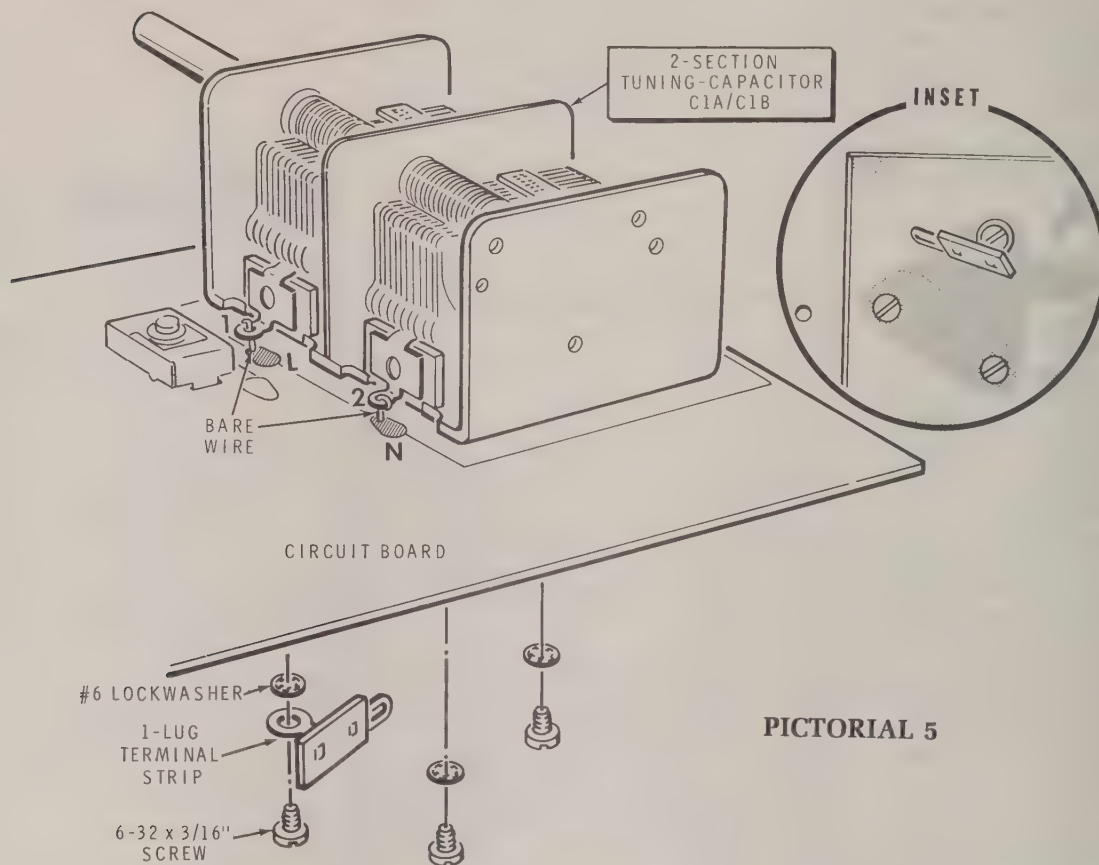


- () R11: 100 k Ω control (#10-941).

- () R27: 10 k Ω control (#10-386).

- () R16: 500 Ω control (#10-918).

CHASSIS ASSEMBLY



PICTORIAL 5

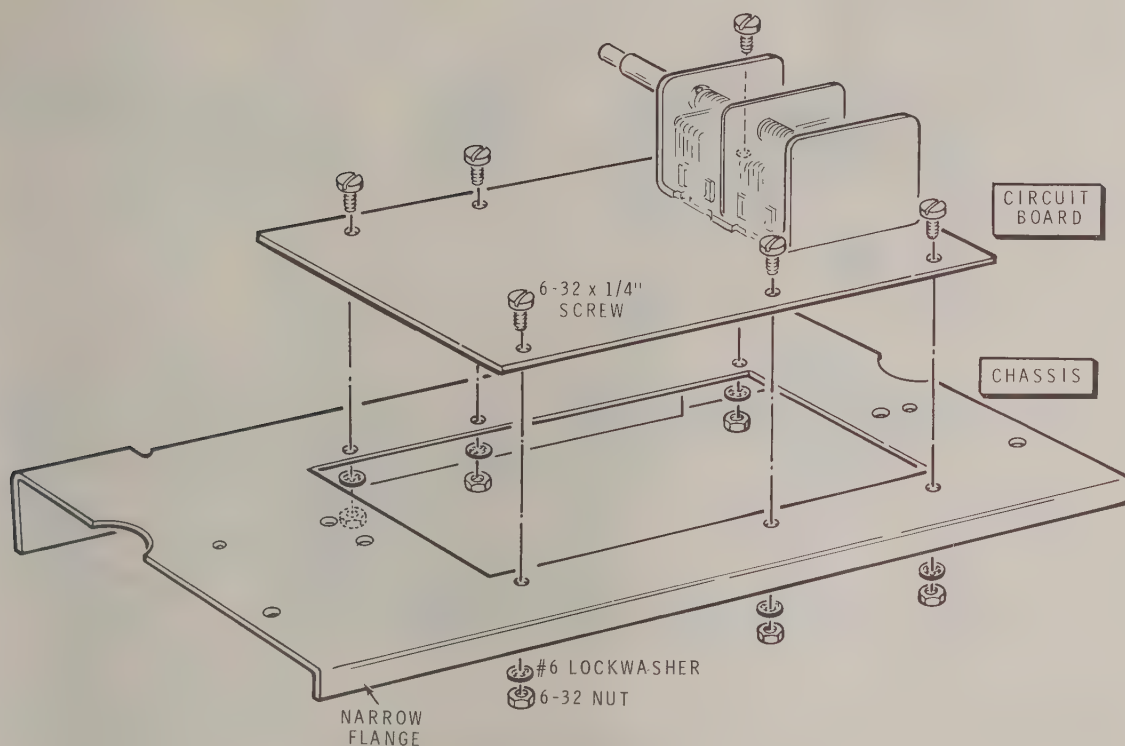
Refer to Pictorial 5 for the following steps.

- () Locate the 2-section tuning capacitor (#26-9) and turn the shaft counterclockwise to fully close the plates. Keep the plates in this position to minimize the chance of damage to the capacitor plates.
- () C1A/C1B: Mount the 2-section tuning capacitor to the circuit board with 6-32 $\times$ 3/16" screws and #6 lockwashers. Mount a 1-lug terminal strip under the screw nearest the shaft and position it as shown in the inset drawing.

- () Cut two 1" red wires. Remove all of the insulation from both wires.

NOTE: In the following steps, (NS) means not to solder the connection because other wires will be added later. (S-) with a number such as (S-3) means to solder the connection. The number following the "S" tells how many wires are in the connection.

- () Connect a 1" bare wire between tuning capacitor C1A/C1B lug 1 (S-1) and circuit board hole L (S-1). NOTE: Make sure the capacitor lug does not touch the trimmer.
- () Connect the other 1" bare wire between tuning capacitor C1A/C1B lug 2 (S-1) and circuit board hole N (S-1).



PICTORIAL 6

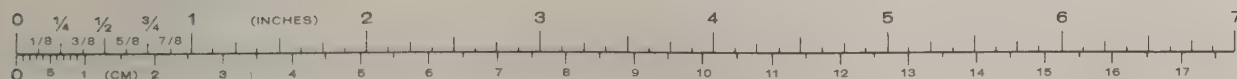
Refer to Pictorial 6 for the following steps.

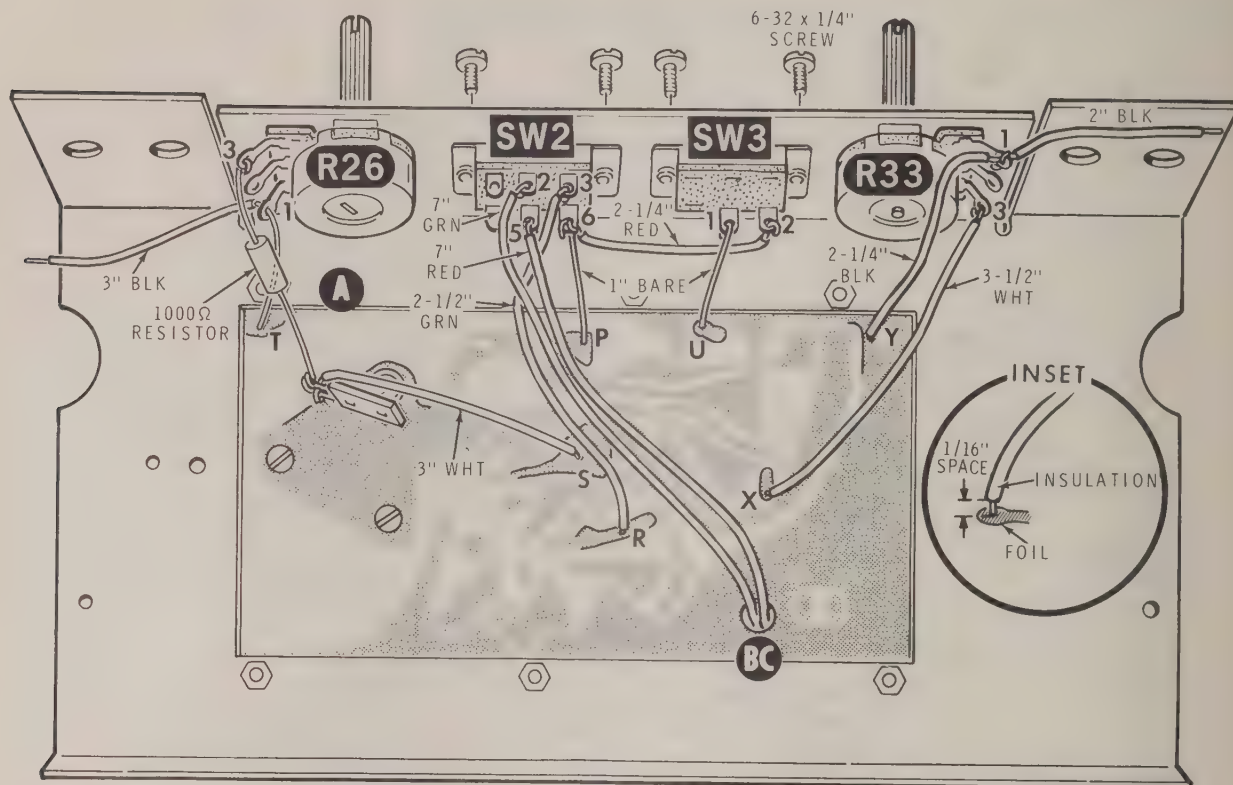
- () Locate the chassis and position it as shown. The side of the chassis with the wider flange is the front. The narrow flange is across the rear of the chassis.

NOTE: When hardware is called for in a step, only the screw size will be given. For instance, if "6-32 x 1/4"

hardware" is called for, it means that a 6-32 x 1/4" screw, one or more #6 lockwashers, and a 6-32 nut should be used for each mounting hole. The Detail referred to in the step will show the proper number and placement of lockwashers.

- () Mount the circuit board to the top of the chassis. Use 6-32 x 1/4" hardware.

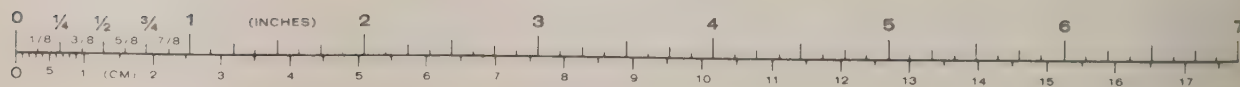


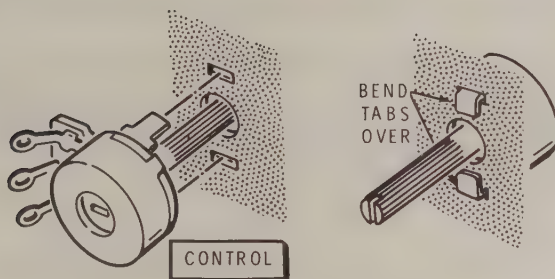


PICTORIAL 7

Refer to Pictorial 7 for the following steps.

- () Position the chassis bottom side up as shown.
- () SW2: Mount a 6-lug slide switch at SW2 on the chassis. Use 6-32 $\times$ 1/4" screws.
- () SW3: In the same manner, mount a 2-lug slide switch at SW3. Be sure to position the switch lugs as shown.
- () R26: Refer to Detail 7A and install a 10 k Ω control at R26. Insert the control tabs through the chassis. Then bend the tabs over. Be sure to position the control lugs as shown.
- () R33: In the same manner, install a 2000 Ω (2K) control at R33. Be sure to position the control lugs as shown.





Detail 7A

NOTE: When you are instructed to prepare wire as in the next step, cut the wire to the indicated length and remove 1/4" of insulation from each end.

- () Prepare the following wires:

3-1/2" white
 2-1/4" black
 2" black
 1" bare (use green wire)
 1" bare (use green wire)
 2-1/4" red
 2-1/2" green
 7" red
 7" green
 3" black
 3" white

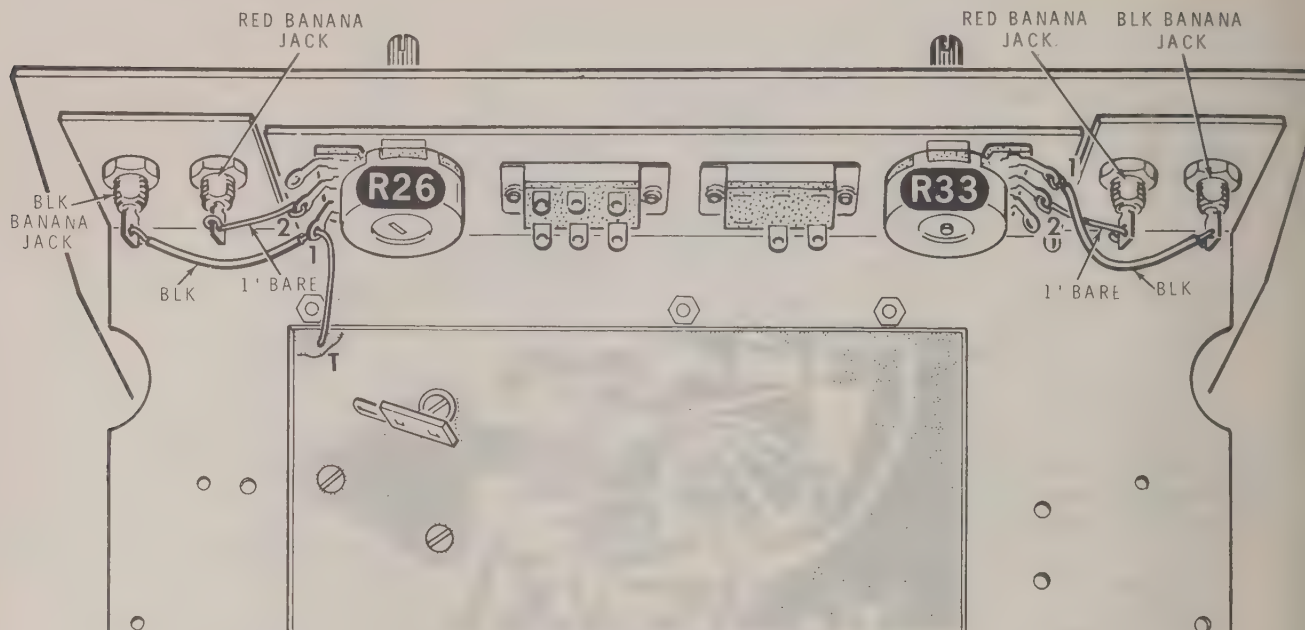
NOTE: When you connect a wire to the foil side of the circuit board as in the next step, position the insulation on the wire up off the foil so the solder can flow in around the bare wire and form a good connection. See the inset drawing. Then cut off the excess lead length from the component side as you connect each wire.

- () Connect a 3-1/2" white wire between control R33 lug 3 (S-1) and circuit board hole X (S-1).
- () Connect a 2-1/4" black wire between control R33 lug 1 (NS) and circuit board hole Y (S-1).
- () Connect one end of a 2" black wire to control R33 lug 1 (S-2). The other end of this wire will be connected later.

- () Connect a 1" bare wire between SW2 lug 6 (NS) and circuit board hole P (S-1).
- () Connect a 1" bare wire between SW3 lug 1 (S-1) and circuit board hole U (S-1).
- () Connect a 2-1/4" red wire between switch SW3 lug 2 (S-1) and SW2 lug 6 (S-2).
- () Connect a 2-1/2" green wire between switch SW2 lug 3 (S-1) and circuit board hole R (S-1).
- () Connect one end of a 7" red wire to switch SW2 lug 5 (S-1). Route the other end of this wire through hole BC. It will be connected later.
- () Connect one end of a 7" green wire to switch SW2 lug 2 (S-1). Route the other end of this wire through hole BC. It will be connected later.

NOTE: Lugs 1 and 4 of SW2 will not be used.

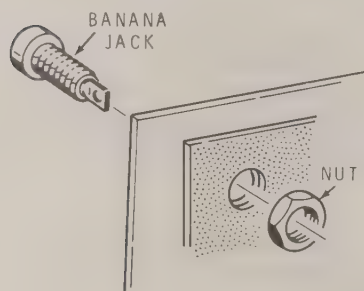
- () Remove an additional 1/2" (3/4" total) of insulation from one end of the 3" black wire. Then insert this bare end through control R26 lug 1 and connect it to hole T on the circuit board. Solder hole T and lug 1. The other end of this wire will be connected later.
- () R34: Connect a 1000 Ω (brown-black-red) resistor between control R26 lug 3 (S-1) and terminal strip A (NS).
- () Connect a 3" white wire from terminal strip A (S-2) to circuit board hole S (S-1). Route this wire over the terminal strip.



PICTORIAL 8

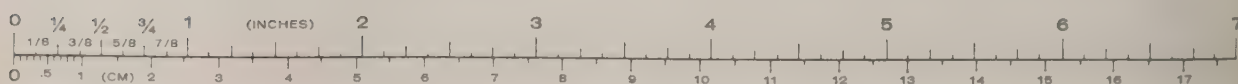
Refer to Pictorial 8 for the following steps.

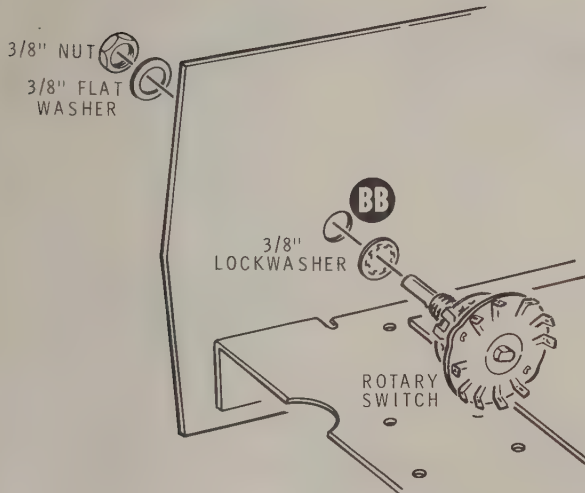
- () Refer to Detail 8A and mount the front panel to the chassis with two red banana jacks and two black banana jacks. Use the hardware supplied on the banana jacks. Be sure to install the red and black jacks as shown.



Detail 8A

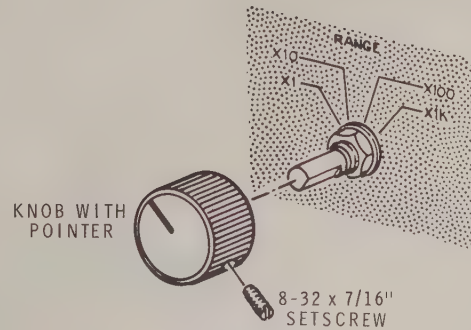
- () Operate the switches and controls and be sure they work freely. Readjust the front panel if necessary.
- () Connect the black wire coming from control R26 lug 1 to the black banana jack (S-1).
- () Cut two 1" green wires and remove all of the insulation. Install these bare wires in the next two steps.
- () Connect a 1" bare wire between control R26 lug 2 (S-1) and the red banana jack (S-1).
- () Connect a 1" bare wire between control R33 lug 2 (S-1) and the red banana jack (S-1).
- () Connect the black wire coming from control R33 lug 1 to the black banana jack (S-1).




Detail 9A

Refer to Pictorial 9 (Illustration Booklet, Page 2) for the following steps.

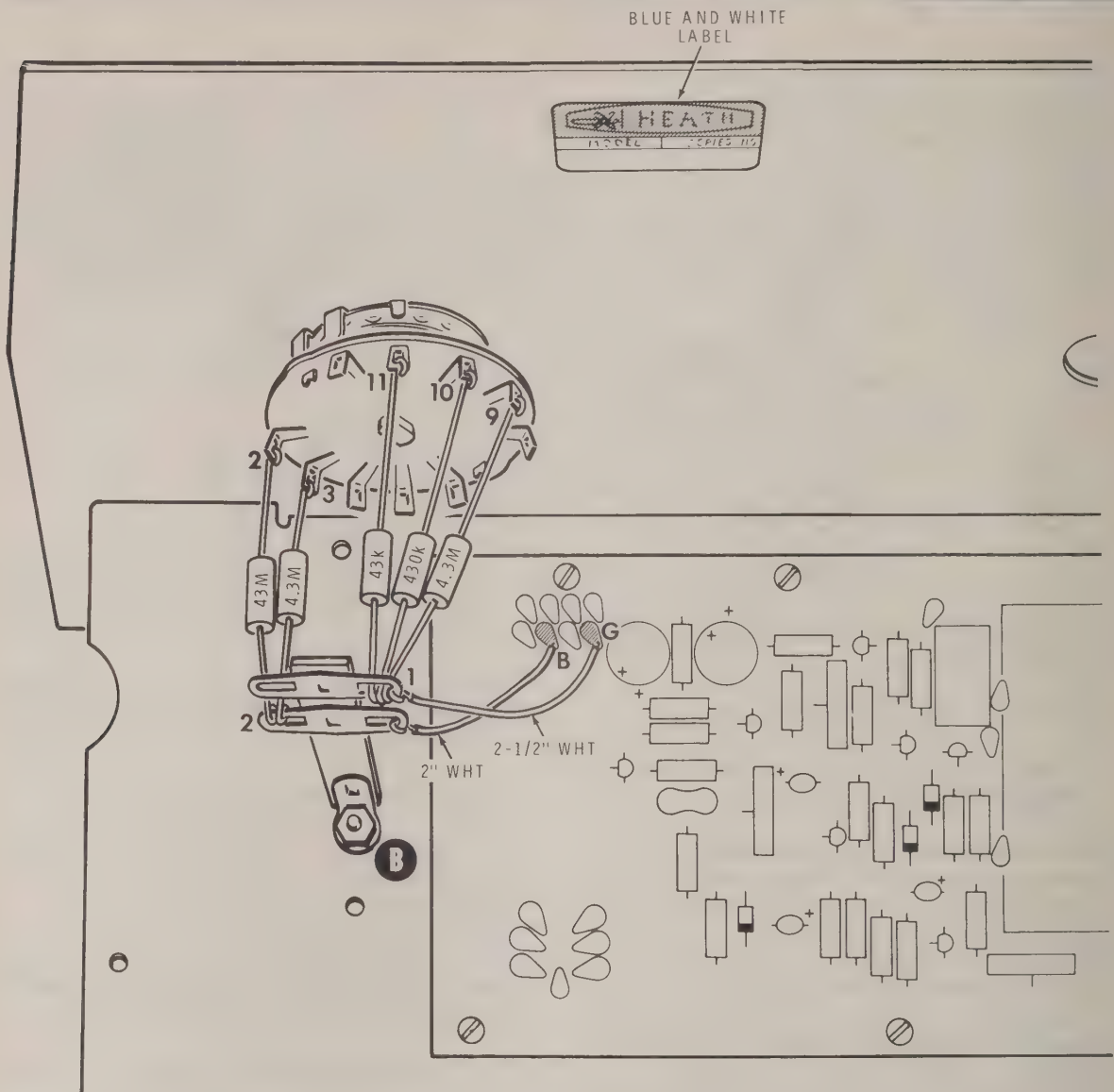
- () Position the chassis right side up as shown.
- () Using a pair of pliers, turn the rotary switch shaft fully counterclockwise.
- () SW1: Refer to Detail 9A and install the rotary switch into the front panel at BB. Use a 3/8" lockwasher, a 3/8" flat washer, and a 3/8" nut. Do not tighten the hardware.
- () Refer to Detail 9B and start 8-32 × 7/16" setscrews into both knobs. Note that one knob has a black pointer; the other knob does not.
- () Slide the knob with the black pointer onto the switch shaft. Then tighten the setscrew against the flat on the shaft.
- () Turn the knob and switch until the pointer aligns with "× 1."
- () Remove the knob, tighten the control nut with the switch in this position, and then replace the knob. Check the pointer position and repeat this step if necessary.


Detail 9B

- () C9: Connect a 2.2 pF (red-red-white) phenolic capacitor between switch SW1 lugs 12 (NS) and 2 (NS).
- () C10: Connect a 2.2 pF (red-red-white) phenolic capacitor between switch SW1 lugs 2 (NS) and 8 (NS).
- () Prepare the following wires:
 - 4" white
 - 5-1/2" white
 - 2" white
 - 2-1/2" white

Connect the wires and resistors between SW1 and the circuit board as follows:

- () 4" wire between lug 6 (S-1) and hole K (S-1).
- () 5-1/2" wire between lug 12 (S-2) and hole J (S-1).
- () R4: 43 kΩ (yellow-orange-orange) resistor between lug 5 (S-1) and circuit board hole A (S-1).
- () R3: 430 kΩ (yellow-orange-yellow) resistor between lug 4 (S-1) and circuit board hole C (S-1).
- () R5: 43 MΩ (yellow-orange-blue) resistor between lug 8 (S-2) and circuit board hole F (S-1).



PICTORIAL 10

Refer to Pictorial 10 for the following steps.

- () Refer to Detail 10A and mount a 2-lug terminal strip at B with 6-32 hardware.

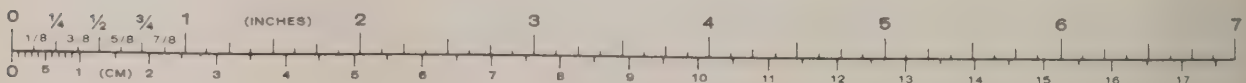
Connect the next five resistors between terminal strip B and SW1.

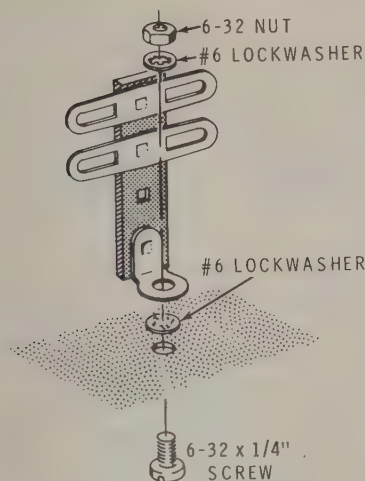
- () R2: 4.3 MΩ (yellow-orange-green) resistor between SW1 lug 3 (S-1) and terminal strip B lug 2 (NS).

- () R1: 43 MΩ (yellow-orange-blue) resistor between SW1 lug 2 (S-3) and terminal strip B lug 2 (S-2).

- () R6: 4.3 MΩ (yellow-orange-green) resistor between SW1 lug 9 (S-1) and terminal strip B lug 1 (NS).

- () R7: 430 kΩ (yellow-orange-yellow) resistor between SW1 lug 10 (S-1) and terminal strip B lug 1 (NS).





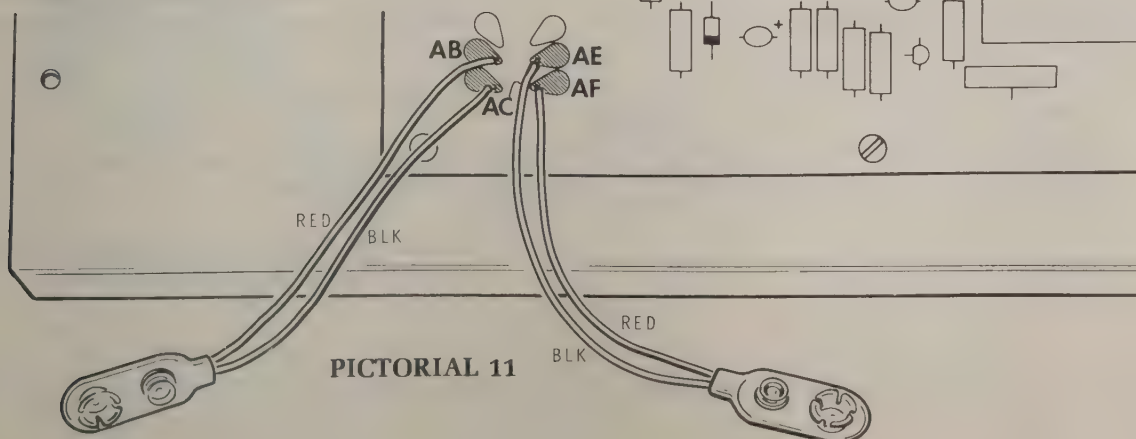
Detail 10A

- () R8: 43 kΩ (yellow-orange-orange) resistor between SW1 lug 11 (S-1) and terminal strip B lug 1 (NS).
- () Connect a 2" white wire between terminal strip B lug 2 (S-1) and circuit board hole B (S-1).
- () Connect a 2-1/2" white wire between terminal strip B lug 1 (S-4) and circuit board hole G (S-1).
- () Carefully peel the paper backing from the blue and white label and press the label into place on the inside of the front panel. Make sure you refer to the numbers on the label in any communications you have with the Heath Company about this kit.

Refer to Pictorial 11 for the following steps.

Connect one of the battery connectors to the circuit board as follows:

- () Red wire to hole AB (S-1).



PICTORIAL 11

- () Black wire to hole AC (S-1).

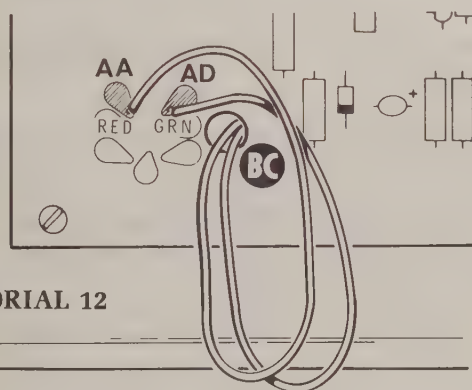
Connect the other battery connector to the circuit board as follows:

- () Black wire to hole AE (S-1).
- () Red wire to hole AF (S-1).

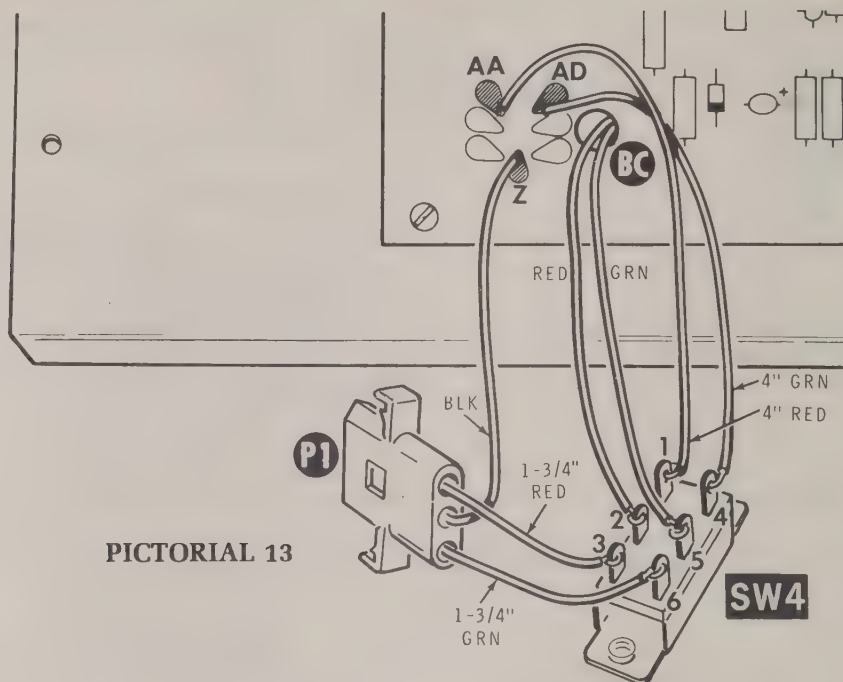
NOTE: If you purchased the AC Power Supply, disregard the next two steps and proceed to "Power Supply Switch and Connector Wiring" on Page 22. If you are going to use battery power ONLY, perform the next two steps and then proceed to "Knob and Dial Pointer Installation" on Page 24. You will need the leftover black, red, and green wires to modify your unit if you purchase the AC power supply later.

Refer to Pictorial 12 for these two steps.

- () Connect the red wire coming from hole BC to circuit board hole AA (S-1).
- () Connect the green wire coming from hole BC to circuit board hole AD (S-1).



PICTORIAL 12



PICTORIAL 13

POWER SUPPLY SWITCH AND CONNECTOR WIRING

When you complete the following steps your unit will operate from the AC power supply or from batteries.

Remove the following parts from the AC power supply kit. Use these parts in the following steps.

Quantity	Description
1	Connector shell with ears
3	Male connector pin
1	6-lug slide switch
1	Mounting plate
2	6-32 $\times$ 1/4" screws

() Prepare the following wires:

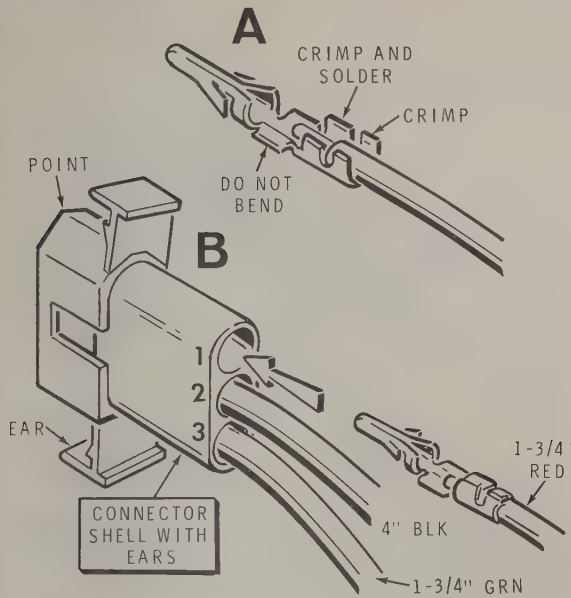
4" black
4" red
4" green
1-3/4" red
1-3/4" green

Refer to Pictorial 13 for the following steps.

- () Connect one end of a 4" black wire to circuit board hole Z (S-1).
- () Connect one end of a 4" red wire to circuit board hole AA (S-1).
- () Connect one end of a 4" green wire to circuit board hole AD (S-1). The other end of these wires will be connected later.
- () Refer to Detail 13A, Part A and crimp and solder a male connector pin onto one end of a 1-3/4" red wire.
- () In the same manner, crimp and solder a male connector pin onto one end of a 1-3/4" green wire.
- () Locate the 6-lug slide switch.

NOTE: In the next step, it does not matter which way the switch is positioned.

- () Connect the free end of the 1-3/4" red wire to switch SW4 lug 3 (S-1).

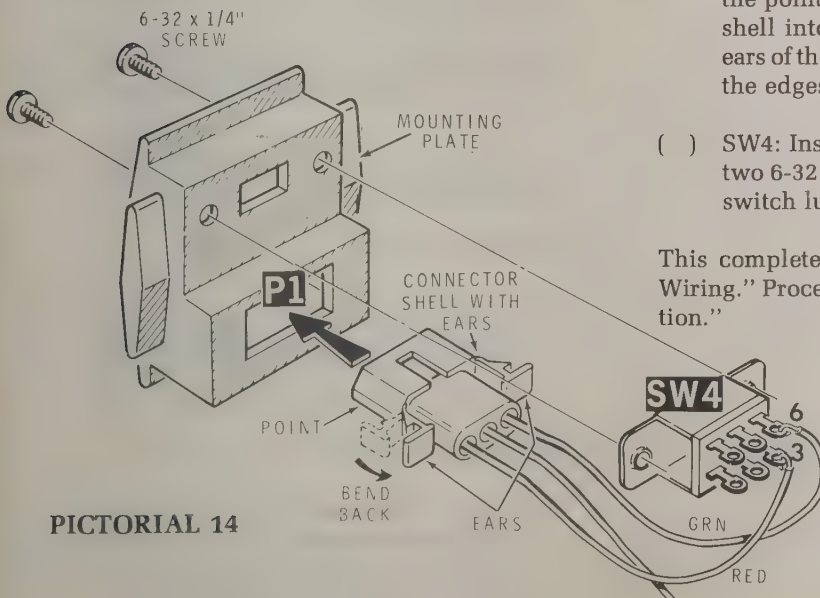


Detail 13A

- () Connect one end of the 1-3/4" green wire to SW4 lug 6 (S-1).
- () In the same manner as before, crimp and solder a male connector pin onto the free end of the black wire coming from hole Z on the circuit board.

- () Refer to Detail 13A, Part B, and position the connector shell with ears with the point as shown. Insert the connector pin on the red wire into the connector shell, hole 1. Press the connector in until it snaps into place. NOTE: The hole numbers are stamped in the back part of the connector.
- () In the same manner, insert the connector pin on the black wire into hole 2 of the connector shell, and the connector pin on the green wire into hole 3.
- () Gently pull on the wires that you just installed. If the pins pull out of the connector shell, push them back in until they "lock" in place.
- () Connect the red wire coming from hole AA on the circuit board to SW4 lug 1 (S-1).
- () Connect the green wire coming from hole AD on the circuit board to SW4 lug 4 (S-1).
- () Connect the red wire coming through hole BC to SW4 lug 2 (S-1).
- () Connect the green wire coming through hole BC to SW4 lug 5 (S-1).

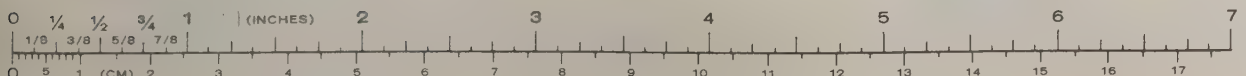
Refer to Pictorial 14 for the following steps.

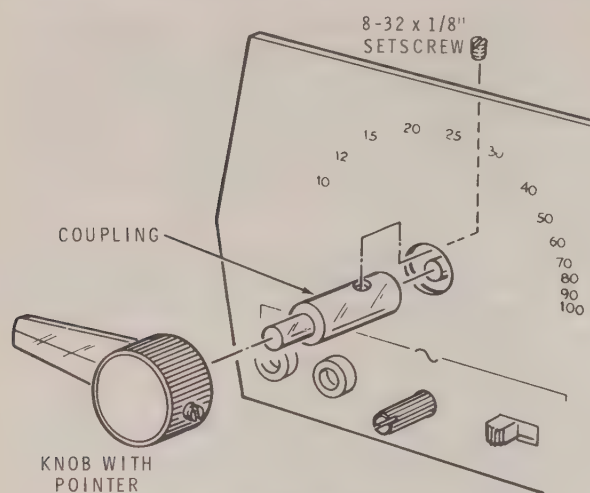


PICTORIAL 14

- () P1: Bend the ears of the connector shell back against the side of the body as shown. Position the pointed end as shown. Push the connector shell into the mounting plate hole at P1. The ears of the connector shell will lock into place at the edges of the hole.
- () SW4: Install SW4 on the mounting plate with two 6-32 × 1/4" screws. Be sure to position the switch lugs as shown.

This completes the "Power Switch and Connector Wiring." Proceed to "Knob and Dial Pointer Installation."



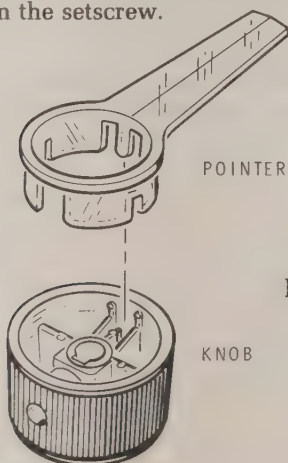


PICTORIAL 15

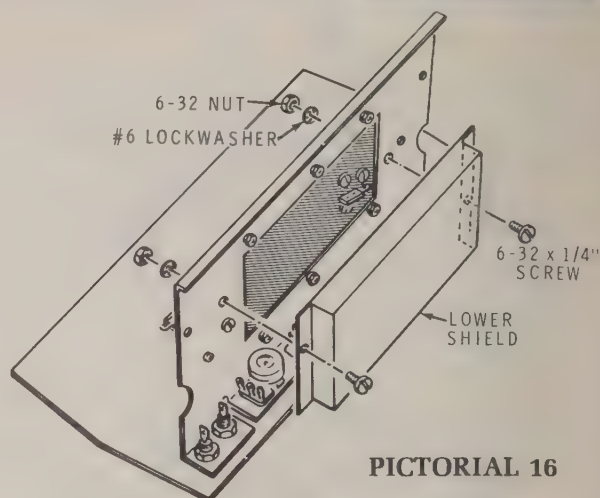
KNOB AND DIAL POINTER INSTALLATION

Refer to Pictorial 15 for the following steps.

- () Locate the coupling and an 8-32 $\times$ 1/8" setscrew. Start the setscrew into the coupling.
- () Slide the coupling onto the tuning capacitor shaft and tighten the setscrew.
- () Refer to Detail 15A and press the pointer into the knob as shown.
- () Make sure the tuning capacitor shaft is fully counterclockwise, and press the knob onto the coupling. Space the pointer 1/16" away from the panel. Then position the dial pointer so the black line on the pointer is horizontal, and tighten the setscrew.



Detail 15A



PICTORIAL 16

This completes the wiring of your Audio Generator. Carefully perform the following checks; then proceed to "Lower Shield Installation."

CHECKOUT

NOTE: Circuit board holes D, E, and H will not be used.

- () Check the foil side of the circuit board for poor solder connections or solder bridges.
- () Cut off any excess lead lengths on the foil side of the circuit board and on the rotary switch, that could touch another foil or connection.
- () Check the transistors to make sure they are correctly installed.
- () Check the electrolytic capacitors to make sure the plus (+) marked leads are correctly installed.
- () Check the diodes for correct position of the banded end.

LOWER SHIELD INSTALLATION

- () Refer to Pictorial 16 and install the lower shield with 6-32 $\times$ 1/4" hardware. Be sure that no wires are pinched under the shield and that the shield does not touch any circuit connections.

TEST LEAD ASSEMBLY

- () Refer to Pictorial 17 (Illustration Booklet, Page 2) and prepare two test leads. Use the black and red test leads (stranded wire); use the black insulator with the black test lead and the red insulator with the red test lead.

TESTS AND ADJUSTMENTS

TESTS

If you do not obtain the correct results in any of the following tests, turn the equipment off. Then refer to the chart following the steps. The chart lists the Condition of the malfunction, and the Possible Cause. Review the items listed in the Possible Cause column and correct the condition before you proceed to the next step. The information in the "In Case of Difficulty" section (Page 32) of the Manual may also help you locate trouble in the kit.

You will need an ohmmeter for the following tests. If you do not have an ohmmeter proceed to "Power Supply Connection" section.

Refer to Pictorial 18 (Illustration Booklet, Page 3) for the following steps.

- () Connect the common lead (–) of an ohmmeter to the chassis of the Generator.
- () Set the meter to the $\times 100$ range.
- () Connect the positive lead (+) to collector Q4 on the generator circuit board. The ohmmeter should indicate a resistance of $1000\ \Omega$ or more when the pointer stops.
- () Set the meter to the $\times 10\text{ k}$ range.
- () Connect the (+) lead to collector Q5. The meter should indicate $100\text{ k}\Omega$ or more.

CONDITION	POSSIBLE CAUSE
Resistance measured considerably less than specified.	Short circuit on circuit board: 1. Check positioning of transistors. 2. Check values of resistors. 3. Check for solder bridges between circuit board foils.
Resistance measured considerably more than specified.	Open circuit(s) on circuit board: 1. Check solder connections. 2. Check resistor values. 3. Check for broken component leads.

POWER SUPPLY CONNECTION

Perform this step only if you are going to use batteries.

- () Connect the two 9-volt batteries, which you purchased earlier, to the battery connectors. If you wired the power supply switch, place this switch in the BATT position.

NOTE: If you are using battery power ONLY, disregard the following steps and proceed to "Adjustments."

- () Connect one of the five connector shells coming from the Power Supply to P1 on the mounting plate. Make sure the wire colors at both connectors are the same and are not reversed. See the inset drawing #1.
- () Place the LINE/BATT switch to the LINE position.
- () Plug the Power Supply line cord into the appropriate AC receptacle.

ADJUSTMENTS

The following controls are located on the Audio Generator circuit board. Refer to Pictorial 18 Part B (Illustration Booklet, Page 3) for their location and position each control at its center of rotation.

- () BIAS ADJ.
- () FEEDBACK ADJ.
- () SYM (symmetry).

- () Preset the FLATNESS ADJ trimmer capacitor as follows: Turn the trimmer screw clockwise until it is snug, then turn it counterclockwise one complete turn.

Set the Audio Generator front panel controls as follows:

- () AMPLITUDE — (both sine and square) fully clockwise.
- () RANGE — $\times 100$.
- () VARIABLE FREQUENCY TUNING dial — Maximum counterclockwise.
- () POWER — ON (both sine and square).

You will adjust your Audio Generator with an AC and DC voltmeter in the following steps. The steps include an extra instruction to adjust the symmetry control using an oscilloscope. This will provide a more effective adjustment, but if you do not have an oscilloscope, you may disregard that step.

- () Set your voltmeter to measure 10-volts DC.
- () Connect the common or black lead to the Generator chassis.
- () Refer to Pictorial 18 Part B, and connect the positive lead to terminal strip B, lug 2.

NOTE: In the following step, the meter will respond slowly due to the capacitors charging in the Generator circuits, and this may make an exact setting difficult. Set the control as close as reasonably possible.

- () Turn the BIAS ADJ control to obtain a meter reading of 0 volts.

NOTE: In the following steps, you will alternately adjust the FEEDBACK ADJ control at the lower frequency end of the band and the FLATNESS ADJ trimmer at the higher frequency end of the band for the most uniform output across the band. No point across the band should exceed 3 volts.

- () Change the voltmeter to measure 3-volts AC, and connect the positive lead to the red sine wave output jack.
- () Turn the FEEDBACK ADJ control to obtain a meter reading of 3 volts (rms).
- () Turn the TUNING dial to its maximum clockwise position.
- () Turn the FLATNESS ADJ trimmer screw to obtain a 3-volt meter reading.
- () Turn the TUNING dial through all frequencies of the X10, X100, and X1k ranges and set the dial at the frequency for the highest meter reading.
- () Turn the FEEDBACK ADJ control to obtain a 3-volt meter reading.

NOTE: Later, when you permanently install the upper shield, the output may drop, particularly at the higher frequency end of the bands. In the following steps, you will adjust the FLATNESS ADJ trimmer to compensate for this effect.

- () Set the RANGE switch to the X1k range.

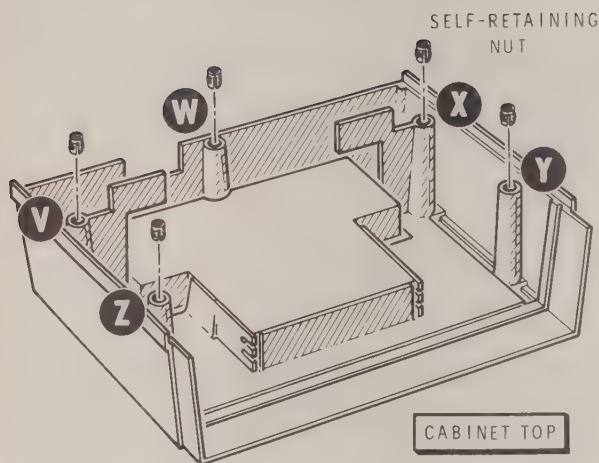
- () Turn the TUNING dial fully clockwise and note the meter reading.
- () Set the shield in place and note the decrease in the meter reading.
- () Remove the shield and adjust the trimmer for an increase in output equal to the effect of the shield.
- () Set the shield into place and check for the same reading you noted above.
- () Repeat this adjustment if necessary.
- () Connect the positive meter lead to the red square wave output jack.
- () Set the meter to DC+ volts.
- () Adjust the SYM control for the highest meter reading, note this value, and then set the control for a meter reading of 1/2 this value.

NOTE: If you have an oscilloscope, you may connect the square wave output to the oscilloscope and adjust the SYM control for 50% duty cycle as shown in the inset.

- () Turn the power switches off.

This completes the "Tests and Adjustments" section. You may want to use this section as a guide to recheck the flatness and symmetry at the output jacks after you do the following "Final Assembly" steps.

FINAL ASSEMBLY



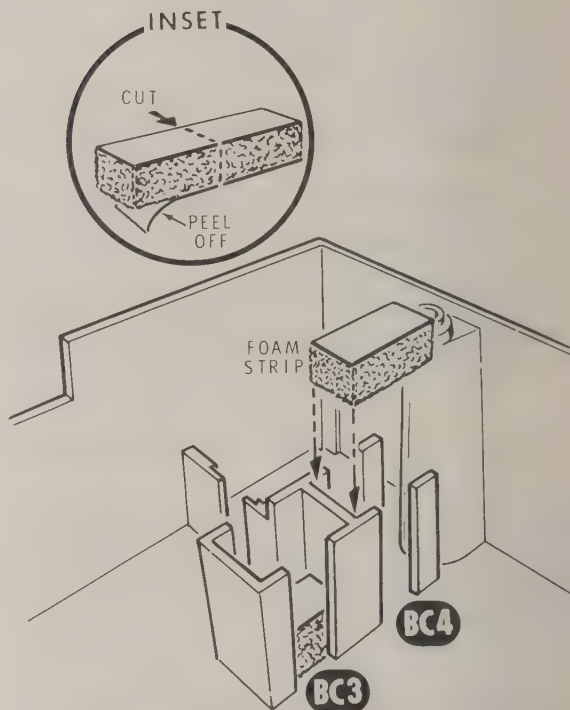
PICTORIAL 19

Refer to Pictorial 19 for the following steps.

- () Position the cabinet top as shown.
- () Install five self-retaining nuts at V, W, X, Y, and Z. Insert the slotted end of the nuts into the cabinet posts. Use a screwdriver handle to push the nuts down into the holes until they are flush with the posts. Set the cabinet top aside temporarily.

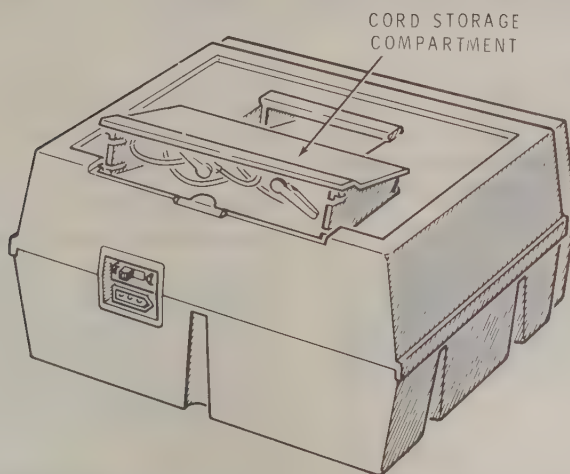
Refer to Pictorial 20 and Detail 20A (Illustration Booklet, Page 4) for the following steps.

- () Install the upper shield with 6-32 $\times$ 3/8" screws (fine thread). Cut a slit in the grommet, as shown in the inset drawing. Put the wires in the grommet.
- () Position the cabinet bottom as shown.



Detail 20B

- () Refer to Detail 20B and cut a foam strip in half as shown in the inset drawing.
- () Remove the backing paper from one side of the cut piece and press it into place at BC3 in the cabinet bottom as shown.
- () In the same manner, press the other half of the foam strip in place at BC4.
- () Refer to Detail 20C (Illustration Booklet, Page 5) and install foam strips in BC1 and BC2.

**Detail 20D**

- () Refer to Detail 20C (Illustration Booklet, Page 5) and install the Audio Generator in the cabinet bottom. Slide the front panel into the cabinet groove. If you are using batteries, install them in compartment BC3 and BC4 as shown. NOTE: You may store spare batteries in compartments BC1 and BC2.
 - () If you are using the AC Power Supply, snap the 9-volt battery connectors onto the retainers on the cabinet bottom. This will keep them secure and out of the way.
 - () Secure the chassis with two #6 $\times$ 3/8" screws (coarse thread).
 - () Install the mounting plate at the rear opening of the cabinet bottom as shown in the inset drawing.
 - () Install the cabinet top on the cabinet bottom. Make sure the front panel slides into the cabinet groove properly.
 - () Install five 6-32 $\times$ 1/2" screws through the cabinet bottom. Tighten the screws securely.
 - () Refer to Detail 20D and store any cables or accessories for your Audio Generator in the cabinet top compartment as shown.
- This completes the "Final Assembly." Proceed to "Operation and Applications."

OPERATION AND APPLICATIONS

OPERATION

Refer to Pictorial 18A (Illustration Booklet, Page 3) which describes each of the front panel controls and terminals.

To select a given frequency, set the TUNING dial to correspond to the first two figures of the frequency. Then set the RANGE switch to the appropriate position to multiply the dial setting by the desired multiplier.

Example:

To select a frequency of 400 Hz, turn the TUNING dial to 40 and the RANGE switch to $\times 10$. Turn the Generator on and adjust the AMPLITUDE as required. The sine wave section must be turned on for the square wave section to operate.

APPLICATIONS

Sine Wave Testing

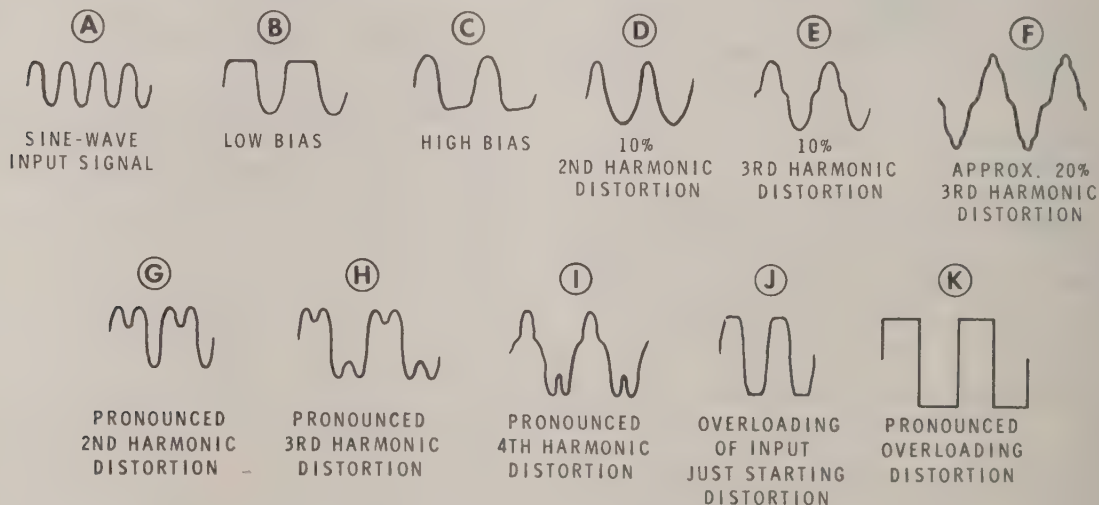
Gain and distortion checks are probably the most common types of sine wave tests that you will make using this Generator. In either of these tests, a single

amplifier stage may be tested separately, or the entire amplifier may be tested.

Pictorial 21 (Illustration Booklet, Page 5) shows typical connections for testing a single stage or a complete amplifier. The output from the Generator may be connected directly to the input of the amplifier being tested. If you connect the signal directly to the input circuit of a transistor or a tube, use a coupling capacitor in series with the signal lead to block any DC voltage that may be present in the circuit.

To test the voltage gain, feed a signal of known amplitude (voltage) into the amplifier input and measure the resulting output. The gain is equal to the ratio of the output voltage divided by the input voltage. You can make this measurement with a voltmeter or an oscilloscope. You can make frequency response tests by determining the gain at various frequencies.

To test for distortion, the output signal from an amplifier can be displayed on an oscilloscope and compared with the input sine wave from the Generator. This test will indicate if distortion is present and, if so, what kind. Pictorial 22 shows waveforms of several kinds of distortion.



TYPICAL DISTORTION PATTERNS OBTAINED IN AUDIO AMPLIFIER TESTING

PICTORIAL 22

SQUARE WAVE TESTING

Square waves are very useful for testing amplifiers, since one square wave will perform several tests simultaneously. This occurs because the square wave is actually a complex waveform made up of many sine waves, which are the fundamental frequency and all of the odd harmonics of that frequency. Therefore, in one operation, the square wave tests a circuit at many different frequencies.

The flat top of the square wave tests the low frequency response of a circuit. This happens because the flat top more closely resembles low frequencies, or short bursts of DC voltage. The vertical portion of the square wave contains high harmonic frequencies that test the response of the amplifier to about ten times the fundamental frequency. Thus, two settings, 100 Hz and 10 kHz would check the frequency response of an amplifier from 10 Hz to 100,000 Hz.

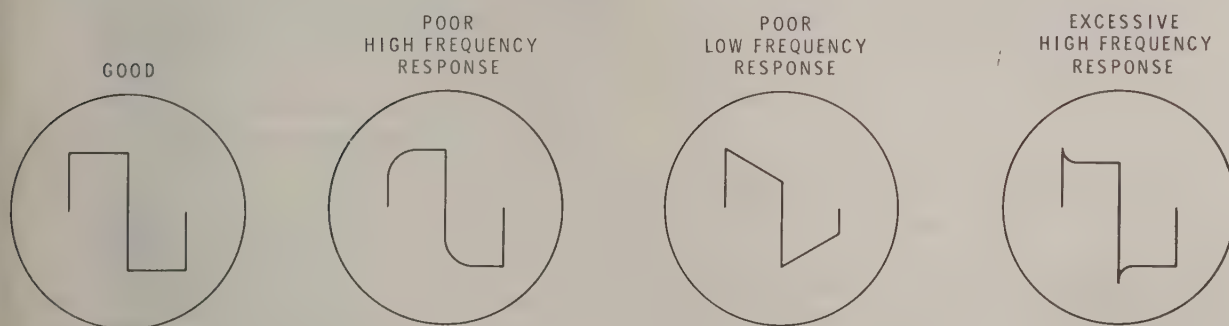
Pictorial 23 shows the types of square wave response patterns that might be seen on an oscilloscope. If the corners of the square wave are rounded off, it means that some of the higher harmonics are missing. If the

flat top portion of the square wave is tilted, it means that the low frequency response of the amplifier is deficient.

Square wave tests are also an excellent way to test the response of the vertical amplifiers of an oscilloscope. Connect the square wave to the oscilloscope vertical input and check the shape of the square wave on the oscilloscope screen.

You can use the sine wave and square wave outputs of your Generator at the same time without detrimental effects to either waveform. This makes recurrent sweep oscilloscopes especially easy to use with this instrument.

For example, when you make stage gain measurements on an amplifier with an oscilloscope, connect the sine wave output of the Generator to the input of the stage being measured. Connect the square wave output to the external sync connector of the oscilloscope. Then you can measure a number of amplifier stages without readjusting the oscilloscope sync controls, regardless of how small or how large the signal is.



PICTORIAL 23

SPECIAL GENERATOR APPLICATIONS

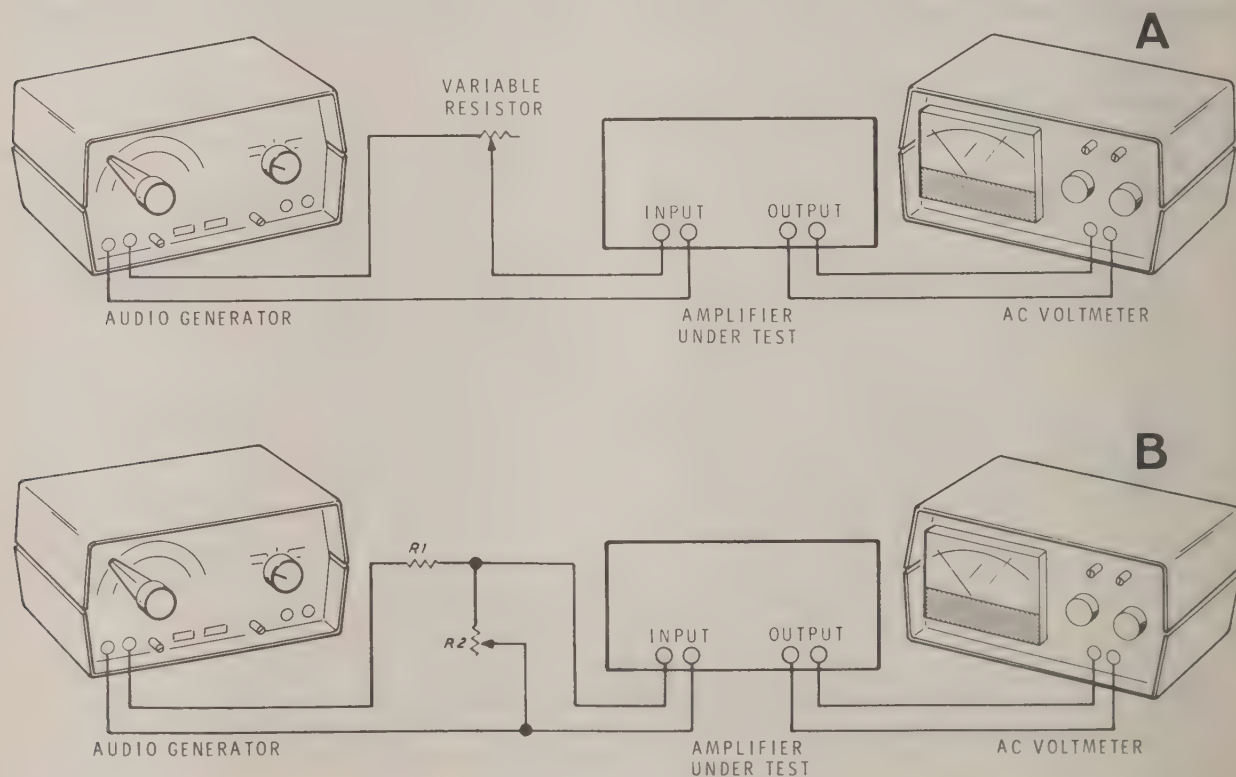
Pictorial 24A and 24B show how to measure the input impedance of an amplifier or of a similar circuit. The method is exact if the impedance is resistive, approximate if it is reactive. For measuring input impedances that are high compared to the Generator output impedance, use the arrangement shown in Pictorial 24A. It may be necessary to use variable resistors of several different values, such as 10 k Ω , 100 k Ω , 1 M Ω , and 5 M Ω , to obtain the correct indication on the external AC meter.

Set the Generator to a low frequency, such as 20 Hz, short out the variable resistor, and set the signal level of the Generator to give a convenient reading on the AC voltmeter. Remove the short from the variable resistor. Then adjust the value of the variable resistor until the reading on the meter drops to 1/2 of the former value. The resistance of the variable resistor is

then equal to the unknown input impedance of the amplifier. You can measure the resistance of the variable resistor with an ohmmeter. If you make this same check at higher frequencies, the input impedance will appear to be smaller because some of the signal will be shorted out by the input capacitance of the amplifier.

For low input impedances, of a few hundred ohms or less, connect the circuit as shown in Pictorial 24B. Fixed series resistor R1 should be at least ten times the input resistance to be measured. The value of this resistor is not important if it is made large enough. Set the output voltage to some convenient value, as before, with variable resistor R2 disconnected from ground.

When R2 is connected again, adjust it until the meter reading drops to half of the former value. The resistance of variable resistor R2 is then equal to the input resistance of the amplifier.



PICTORIAL 24

IN CASE OF DIFFICULTY

This part of the Manual will help you locate and correct difficulties which may occur in your Audio Generator. It is divided into two sections. The first section, "General," contains suggestions of a general nature in the following areas:

- Visual check and inspection.
- Precautions to observe when bench testing.

The second section is a "Troubleshooting Chart" which contains a series of "Conditions" and "Possible Causes." Start your troubleshooting procedure by first reading the following "General" section. Then proceed to the appropriate "Condition" and "Possible Cause."

GENERAL

Visual Checks

1. About 90% of the kits that are returned for repair do not function properly due to poor soldering. Therefore, you can eliminate many troubles by a careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes." Reheat any doubtful connections and be sure all the wires are soldered at places where several wires are connected. Check carefully for solder bridges between circuit board foils.
2. Check to be sure the transistors are in their proper locations and are installed correctly.
3. Check the value of each part. Be sure that the proper part is wired into the circuit as shown in the Pictorial diagrams, and is called out in the wiring instructions.

Be sure the correct diode is installed and that the banded end is positioned correctly.

Check each electrolytic capacitor to be sure the lead near the positive (+) marking is at the correct position.

4. Re-check the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is fre-

quently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.

5. Check all component leads connected to the circuit boards. Make sure the leads do not extend too far through the circuit board and make contact with other connections or parts.
6. Check all of the wires that are connected to the circuit board to be sure the wires do not touch the chassis. Make sure all wires are properly soldered.

Precautions for Bench Testing

- Be cautious when you test transistors. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage and current than other circuit components.
- Be careful so you do not short any terminals to ground when you make voltage measurements. If the probe slips, for example, and shorts out a bias or voltage supply point, it may damage one or more components.

Do not remove any components from the circuit board while the unit is turned on.

When you make repairs, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, make sure you find out what (wiring error, etc.) caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may become damaged when the unit is put back into operation.

Refer to the "X-Ray Views," "Identification Charts," and the "Schematic Diagram" (fold-in) to locate the various components.

Troubleshooting Chart

The following chart lists possible causes of specific malfunctions. If a particular part is mentioned (Q1 for example) as a possible cause, check that part and other components connected to that part to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

PROBLEM	POSSIBLE CAUSE
No sine wave output.	Q1, Q2, Q3, Q4, Q5. D1, D2, D3. R16 misadjusted.
DC voltage on sine wave output.	R11 misadjusted.
Operates on one end of band only.	C2 misadjusted.
No square wave output.	Q6, Q7. R27 misadjusted. No sine wave output.

SPECIFICATIONS

Frequency Output	10 Hz to 100 kHz in four ranges.
Sine Wave Output Voltage	0 — 3 volts rms
Square Wave Output Voltage	0 — 3 volts peak.
Power Supply	Two 9-volt Eveready #216 batteries or IPA-5280-1 Power Supply.
Dimensions	11" high × 5-3/4" wide × 7-3/4" deep. (27.9 cm high × 14.6 cm wide × 19.7 cm deep.)
Net Weight	3-1/2 lbs. (1.6 kg).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram as you read this Circuit Description.

A sine wave generating circuit and a square wave section make up the Audio Generator. The power is supplied by two 9-volt batteries or the Model IPA-5280-1 Power Supply.

A Wien-bridge type oscillator generates the sine wave. Transistors Q1 and Q3 provide the amplification. Q1 also provides a high impedance input to minimize loading of the frequency determining network. This network is formed by tuning capacitor C1A and C1B and a pair of resistors. C1A and C1B provide tuning through each individual range. The Range switch, SW1, selects one of the four ranges by connecting a pair of resistors into the circuit; R1 and R5, R2 and R6, R3 and R7 or R4 and R8.

Bias adjust resistor R11 determines the proper bias level for Q1 so 0 volts appears at the output, point C.

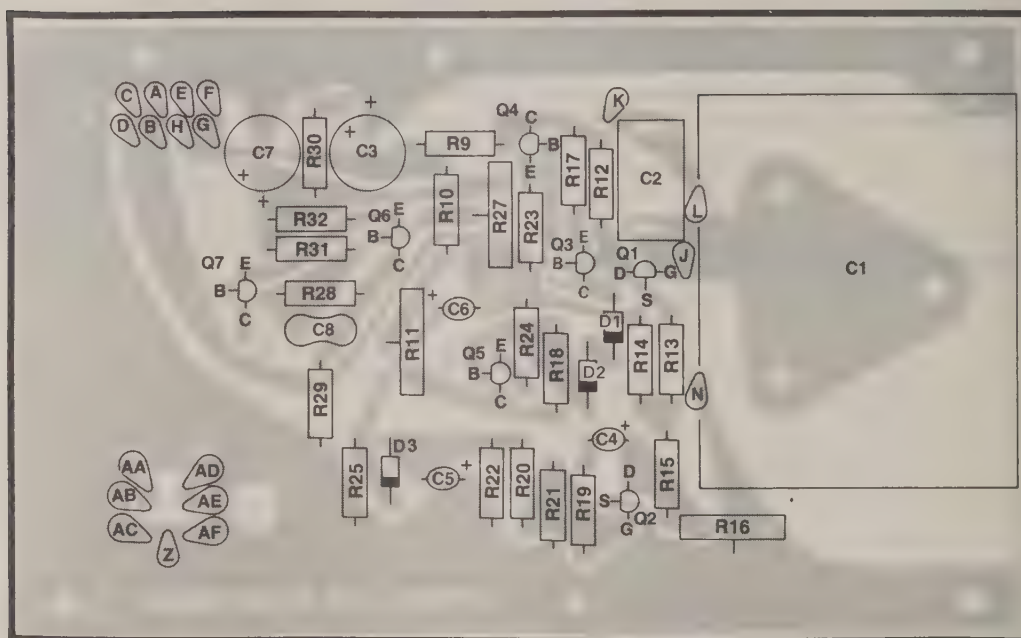
The oscillator output voltage is rectified by diode D3 and is applied to the gate of Q2. Q2 acts as a variable resistor to control the bias of Q1. This is a feedback path which helps keep the circuit oscillating at the level determined by the setting of R16. Further feedback is provided by R14 from the output to the source of Q1. The gate of Q2 is coupled through C4 and R19 to the source of Q1 to help reduce the distortion level of the oscillator. D1 and D2 maintain a 1.2-volt difference between the bases of Q4 and Q5. Q4 and Q5 are an emitter-follower complementary pair and provide a low impedance output.

When SW3 is on and the sine wave section is operating, the square wave section is in operation. Q6 and Q7 form a Schmitt trigger circuit. The sine wave (coupled through Symmetry control R27) controls its two states. The control may be adjusted to provide a 50% duty cycle at the output control, R33. The square wave is referenced to ground and will always be a positive-going voltage. R30 and C7 isolate the square wave circuit supply from the sine wave circuit supply.

CIRCUIT BOARD X-RAY VIEW

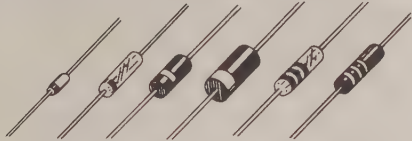
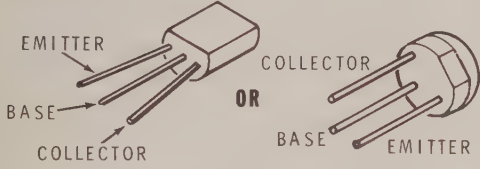
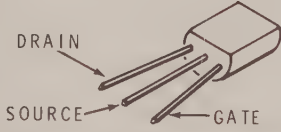
NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A. Find the circuit component number (R5, C3, etc.) on the X-Ray View.
- B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.
- C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



VIEWED FROM COMPONENT SIDE

SEMICONDUCTOR IDENTIFICATION CHART

SCHEMATIC NUMBER	HEATH PART NUMBER	MANUFACTURER'S NUMBER	LEAD IDENTIFICATION
D1, D2, D3	56-56	1N4149	
Q3, Q5, Q6, Q7	417-235	2N4121	
Q4	417-801	MPSA20	
Q1, Q2	417-169	MPF105	

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE**INSTRUCTIONS**

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, \$3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

Total enclosed \$ _____

- If you prefer COD shipment, check the COD box and mail this card. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date _____ Location _____

Purchased _____ Purchased _____

LIST HEATH PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE

TOTAL FOR PARTS

HANDLING AND SHIPPING

MICHIGAN RESIDENTS ADD 4% TAX

TOTAL AMOUNT OF ORDER

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE**INSTRUCTIONS**

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MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022



MP MASTER



MA23044

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THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

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